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A vegetation classification and description of Telperion Nature Reserve, Mpumalanga, South Africa

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Abstract

Aims: This study identified, classified and mapped the different plant communities found on the Telperion Nature Reserve. **Study area:** Telperion Nature Reserve, Mpumulanga, South Africa. **Methods:** Using a 1:10,000 aerial photograph, Telperion was delineated into homogenous physiognomic-physiographic units. 294 sample plots (100 m^2) were placed in a randomly stratified manner within identified homogenous units. Plant species present in sample plots were recorded and allocated a modified Braun-Blanquet cover abundance scale value. Sample plot data were captured into TURBOVEG and exported for editing, classification and processing in JUICE. A modified TWINSPAN classification was applied to derive a first approximation of the plant communities in a synoptic table that was refined using Braun-Blanquet procedures. Species were manually arranged into groups. Diagnostic, constant and dominant species were statistically determined from the synoptic table. Threshold values for fidelity, frequency and canopy cover were set and a final phytosociological table was produced for describing the plant species composition for the different plant communities. **Results:** 22 plant communities were identified for Telperion. Five were major communities, 14 were sub-communities and 13 were variants. The five major plant communities were *Cyathea dregei–Ilex mitis* ravine woodland, *Paspalum urvillei–Phragmites australis* valley bottom wetland, *Diospyros lycioides–Combretum erythrophyllum* riparian woodland, *Eragrostis curvula–Seriphium plumosum* midslope plateau grassland, and *Combretum molle–Englerophytum magalismontanum* rocky ridge woodland. The plant communities were also described and mapped. **Conclusions:** The classification, description and mapping of Telperion's vegetation provides a basis for management decision making about wildlife stocking rates, fire planning, and vegetation management. Findings indicate that Bankenveld vegetation is heterogeneous with a variety of habitats including woodland and grassland components. Telperion has a variety of plant communities and a high plant species diversity, making it a reservoir for plant species and an important conservation area.

Taxonomic reference: SA-Plant Checklist-2019–2020, South African National Biodiversity Institute, 2020, Botanical Database of Southern Africa (BODATSA) (http://posa.sanbi.org/) [accessed January 2022].

Abbreviations: BB = Braun-Blanquet; m a.s.l. = metres above sea level; TWINSPAN = Two-way indicator species analysis.

Keywords

Braun-Blanquet, diversity, habitat type, modified TWINSPAN, plant community, Telperion

PENSOFT

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Introduction

Vegetation is the most physical representation of the environment (Kent 2012) and subsequently all life on Earth is directly or indirectly dependent on the existence thereof (Randall 1978; Van As et al. 2012). Plants offer many goods and services to humans such as food, medicines, fibre, wood, paper, energy and shelter (Kaufman 1989). Vegetation also provides a habitat for various wildlife species. Plant diversity is important from a genetic point of view as it influences the "evolutionary potential" of a plant community/plant species and the way it will react to changes in the environment (natural or anthropogenic). The conservation of biodiversity is therefore important since it influences the genetic variation of plants that affects their ability to survive (Frankel et. al. 1995; Swanson 1998).

The Grassland Biome in South Africa forms part of the world temperate grassland biome that extends from 37°21' North to approximately 34°51' South Latitude (Mucina and Rutherford 2006). It occupies 29% of South Africa's land surface, making it the second largest biome in the country (Reyers et al. 2001). The grasslands of South Africa are located at mid to high altitudes (1,200–3,400 m a.s.l.) and occur mainly on the high and central plateau areas that include warm and cool temperate grasslands (Brown and Bezuidenhout 2020). The warm-temperate grasslands are dominated by C4 grasses and the cool-temperate grasslands are dominated by C3 grasses (Van Oudtshoorn et al. 2011). The largest part of grasslands borders onto the savanna biome, both having strong seasonal rainfall and similar summer rainfall patterns. They are differentiated by summer aridity and minimum winter temperatures (Mucina and Rutherford 2006). Because grasslands' soil, geology and topography make them suitable to mining, agriculture and urbanisation, this biome is one of the most impacted and as a result threatened ecosystems (Brown and Du Preez 2014) in southern Africa.

Grasslands are diverse in terms of species composition and vegetation structure, and have high plant biodiversity (Brown and Bezuidenhout 2020). They are also important in terms of the wildlife biodiversity that they support and are a source of fresh water with waterflow regulating capability (Bengtsson et al. 2019; Brown and Bezuidenhout 2020). To ensure their long-term functioning, it is important that grassland ecosystems are classified and described. Doing this allows land managers to implement and affect scientifically sound conservation practices in these ecosystems. This article delineates, classifies, describes and maps the various plant communities found on the Telperion Nature Reserve.

Study area

Telperion Nature Reserve (Telperion) is a privately owned reserve that is located approximately 25 km east of Bronkhorstspruit in the Mpumalanga Province of South Africa (Fig. 1). The reserve lies on the border of the Gauteng and Mpumalanga provinces at 25°38'24"S latitude and 28°44'24"E longitude. Telperion falls within the larger Bankenveld vegetation type (Acocks 1988). According to Mucina and Rutherford (2006) this mesic highveld grassland area belongs to the endangered Rand Highveld grassland (Gm 11) with rocky mountainous sections classified as Loskop Mountain Bushveld (SVcb 13) and smaller sections of Eastern Highveld grassland (Gm 12). Topographically Telperion consists of undulating hills, open plateaus and steep slopes. Altitude varies from 1240 to 1503 m a.s.l. (Coetzee 2011). Telperion is situated in the summer rainfall area of South Africa. Annual rainfall in this region ranges between 570 mm and 730 mm (Mucina and Rutherford 2006). Average temperature for the region suggests that February is the hottest month of the year, with an average daily maximum of 26.4 °C and an average daily minimum of 15.1 °C. July is the coldest month of the year with an average daily maximum of 18.4 °C and an average daily minimum of 4.2 °C.

Methods

Sampling

A 1:10,000 aerial photograph was used to delineate the reserve into physiognomic-physiographic units. After a ground reconnaissance of the delineated units, a total of 294 sample plots (100 m^2) were placed in a randomly stratified manner (Brown et al. 2013) within the different homogenous units identified. Sample plots were placed in such a manner to ensure that all vegetation components of the different homogeneous units identified had an even chance of being selected (Kent 2012; Brown et al. 2013). The number of sample plots per homogeneous unit depended on its size. More plots were placed in larger units than in smaller units. A minimum of three plots were placed in each delineated unit in accordance with Brown et al. (2013). Ecotones were not sampled. All plant species present in the sample plots were recorded and given a cover abundance value using the modified Braun-Blanquet (BB) cover abundance scale (Mueller-Dombois and Ellenberg 1974; Westhoff and Van der Maarel 1978).

Environmental data collected in each of the sample plots included slope, aspect and soil type. Other factors having an impact on the vegetation in the sample plots such as trampling, overgrazing, bare soil patches, alien plant species, animal droppings, signs of browsing, and old fields were also noted. Structural terminology is according to Edwards (1983). No attempt was made to formally fix syntaxa names as this is normally avoided in detailed local studies in South Africa (Brown et al. 2013).

Data analysis

Floristic data was analysed according to BB procedures and was captured using the database programme TURBOVEG (Hennekens and Schaminee 2001). Captured data was exported for analysis using the JUICE programme (version

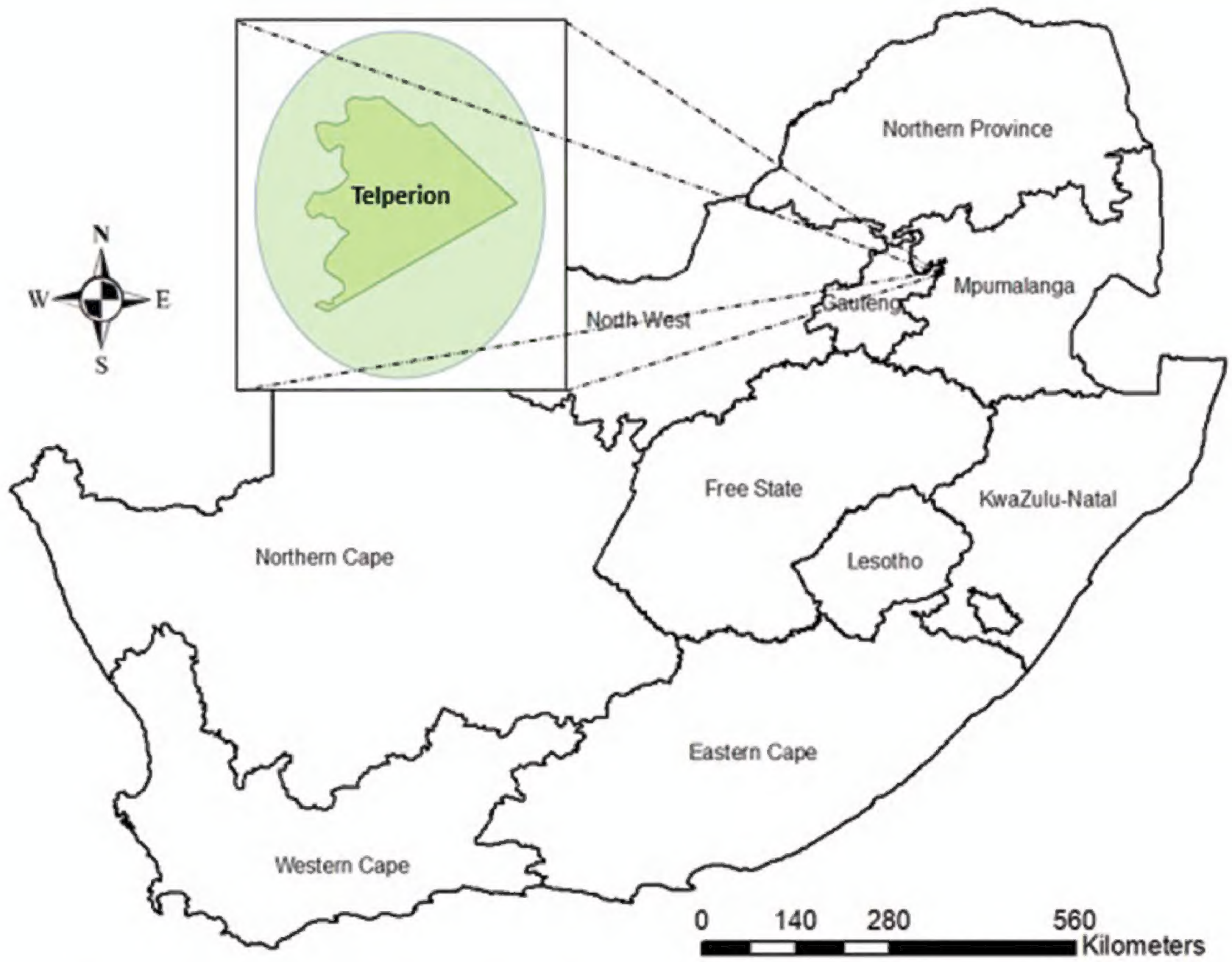

Figure 1. Location of Telperion Nature Reserve in the Mpumalanga province, South Africa.

7.1, https://www.sci.muni.cz/botany/juice/?idm=13). JUICE is a Microsoft Windows application for editing, classifying and analysing large phytosociological tables and databases (Tichý 2002).

A modified TWINSPAN classification (Roleček et al. 2009) was applied to the data to derive a first approximation of the plant communities. The fidelity measure used was a phi-coefficient of association, which is based on the presence and absence of species. Pseudospecies cut levels were set at 0-5-15-25-50-75 as recommended by Brown et al. (2013). The resultant phytosociological table was refined using BB procedures as described by Brown et al. (2013). Species were manually arranged into groups, but the clusters were not re-arranged. Diagnostic, constant and dominant species as statistically determined from the synoptic table were identified and listed for each plant community. The threshold values were set as follows: 60 (lower) and 70 (upper) for fidelity; 70 (lower) and 90 (upper) for frequency; 25 (lower) and 100 (upper) for canopy cover.

The resultant phytosociological table was used to describe the plant species composition of the different plant communities. Plant community names were assigned in accordance with the recommendations by Brown et al. (2013). Characteristic species are regarded as those that are largely restricted to a specific plant community and do not necessarily have a high cover-abundance value (Brown and Bezuidenhout 2005). The different plant communities are described according to their dominant species. These are species that are most conspicuous in the community with constant high cover-abundance values, as well as constant high frequency values (Whittaker 1978).

Species richness of the plant communities was determined by totalling the number of species present in each. To calculate species diversity the cover-abundance data collected using the Braun-Blanquet surveys were transformed to a numerical scale (r = 0.5; + = 1; 1 = 2; 2a = 8.5; 2b = 17.5; 3 = 35; 4 = 70; 5 = 140) as described by Van der Maarel (2007). Diversity was determined for each plant community using the Shannon-Wiener Index of diversity (H') (Shannon and Weaver 1949) and the Rich-Gini-Simpson Index of diversity (RGS) (Guiasu and Guiasu 2010).

$$\text{Shannon} - \text{Wiener Index } (H) = -\sum_{i=1}^{s} p_i \ln p_i$$

$$\text{Rich} - \text{Gini} - \text{Simpson Index } (RGS) = n \sum_{i} p_i (1 - p_i)$$

To enable appropriate comparisons between the different communities, the diversity results from the indices were converted to true diversities as described by Jost (2006).

$$\text{Effective number} = \exp\left(-\sum_{i=1}^{s} Pi \ln Pi\right)$$

Diversity comparisons were done for the various plant communities using a Kruskal-Wallis ANOVA (Zar 2014).

Results

Plant community classification and description

The modified TWINSPAN classification resulted in the identification of 22 plant communities that can be grouped into five major plant communities. The different plant communities are listed below and presented in a synoptic table in Table 1 and as a detailed phytosociological table in Suppl. material 1. A visual depiction of the distribution of various plant communities found at Telperion is presented in Fig. 2. References to the different species groups in Table 1 from subsequent text will not be accompanied by the table number. Representative photos of the major plant communities are included in Suppl. material 2.

1. *Cyathea dregei–Ilex mitis* ravine woodland
   - 1.1. *Cyathea dregei–Ilex mitis–Pteridium aquilinum* woodland
   - 1.2. *Cyathea dregei–Ilex mitis–Celtis africana* woodland
2. *Paspalum urvillei–Phragmites australis* valley bottom wetland
   - 2.1. *Paspalum urvillei–Phragmites australis–Populus × canescens* woodland
   - 2.2. *Paspalum urvillei–Phragmites australis–Imperata cylindrica* grassland
     - 2.2.1. *Verbena bonariensis* variant
     - 2.2.2. *Schoenoplectus corymbosus* variant
   - 2.3. *Paspalum urvillei–Phragmites australis–Miscanthus junceus* grassland
   - 2.4. *Paspalum urvillei–Phragmites australis–Ischaemum fasciculatum* grassland
3. *Diospyros lycioides–Combretum erythrophyllum* riparian woodland
   - 3.1. *Diospyros lycioides–Combretum erythrophyllum–Searsia pyroides* woodland
   - 3.2. *Diospyros lycioides–Combretum erythrophyllum–Searsia lancea* woodland
4. *Eragrostis curvula–Seriphium plumosum* midslope plateau grassland
   - 4.1. *Eragrostis curvula–Seriphium plumosum–Digitaria eriantha* grassland
     - 4.1.1. *Indigofera zeyheri* variant
     - 4.1.2. *Ochna pulchra* variant
   - 4.2. *Eragrostis curvula–Seriphium plumosum–Burkea africana* woodland
   - 4.3. *Eragrostis curvula–Seriphium plumosum–Eragrostis racemosa* grassland
     - 4.3.1. Typicum variant
     - 4.3.2. *Loudetia simplex* variant
     - 4.3.3. *Setaria sphacelata* variant
5. *Combretum molle–Englerophytum magalismontanum* rocky ridge woodland
   - 5.1. *Combretum molle–Englerophytum magalismontanum–Croton gratissimus* woodland
     - 5.1.1. *Clutia pulchella* variant
     - 5.1.2. *Vepris reflexa* variant
     - 5.1.3. *Brachylaena rotundata* variant
     - 5.1.4. *Diplorhynchus condylocarpon* variant
   - 5.2. *Combretum molle–Englerophytum magalismontanum–Protea caffra* woodland
     - 5.2.1. *Rhynchosia nitens* variant
     - 5.2.2. *Ocimum obovatum* variant
   - 5.3. *Combretum molle–Englerophytum magalismontanum–Boophone disticha* woodland

1. *Cyathea dregei–Ilex mitis* ravine woodland

Locality and habitat: This community is found on steep moist ravine areas at the edge of the large central plateau close to the western boundary of Telperion. The altitude for this plant community varies from 1344 to 1446 m a.s.l. The community is located on mid-slopes and the slope varies from steep to moderate with a gradient of between 18° and 35°. Rock cover varies from 1%–95%, with an average of 38%. This community has gravely, shallow sandy leached soil. This plant community is represented by 9 relevés with an average of 13 different plant species recorded per sample plot.

Vegetation description: Diagnostic species for this community include *Cyathea dregei* and *Ilex mitis* (species group A). Constant species include *Asparagus laricinus*, *Bidens pilosa* (species group L), *Paspalum urvillei* (species group D) and *Plectranthus hereroensis* (species group C). This community is characterised by the trees *Cyathea dregei*, *Ilex mitis* and *Halleria lucida* (species group A). The vegetation is dominated by a woody layer with *Cyathea dregei* (species group A) and the grass *Paspalum urvillei* (species group D) being dominant. The estimated tree cover for the community ranges between 10% and 80%, with an average of 53%. The shrub layer covers between 5% and 15% (average 11%), while the grass layer covers between 3% and 80%, with an average of 20%. The forb layer covers between 1% and 10% with an average of 7%.

The vegetation is dense in the ravine areas and becomes more open with less woody species and more grasses in-between the rocks as one moves higher up the midslope. On the outer edges of the community where there are less trees and where the area is less steep, the grass *Paspalum urvillei* becomes very prominent. The alien invasive shrub *Rubus rigidus* (species group N) is locally prominent in certain areas along the southern slopes next to the stream and poses a threat to the indigenous vegetation. The undergrowth is mostly sparse due to a high canopy cover and a dense woody layer. Minimal signs of wildlife were noted within this community. This plant community is divided into two sub-communities.

1.1 *Cyathea dregei–Ilex mitis–Pteridium aquilinum* woodland sub-community

Vegetation description: This sub-community is characterised by the presence of the forb *Pteridium aquilinum* (species group B). The vegetation is dominated by the trees *Cyathea dregei*, *Ilex mitis* (species group A), and the grasses *Paspalum urvillei* and *Phragmites australis* (species group D).

Table 1. Synoptic table of relevés. The values represent constancy of the species as a percentage frequency. Dark grey represents characteristic species of major communities and light grey characteristic species of sub-communities. The detailed phytosociological table is given in Suppl. material 1.

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Species group A														
Cyathea dregei	67	100	–	–	–	–	–	–	–	–	–	1	–	–
Ilex mitis	67	100	–	–	–	–	–	–	–	–	–	14	–	11
Halleria lucida	67	67	–	–	–	–	–	–	–	–	–	3	–	–
Species group B														
Pteridium aquilinum	67	–	29	–	19	–	–	6	17	6	–	6	–	–
Species group C														
Plectranthus hereroensis	17	100	–	–	–	–	–	–	4	6	–	37	35	33
Species group D														
Phragmites australis	17	–	100	55	38	17	67	76	–	–	–	–	–	–
Paspalum urvillei	83	100	57	52	75	33	–	12	–	–	5	–	–	–
Thelypteris confluens	33	–	57	28	56	–	–	–	–	–	–	3	3	–
Typha capensis	–	–	–	10	19	–	–	–	–	–	–	–	–	–
Species group E														
Populus x canescens	–	–	57	7	–	–	17	12	–	–	–	–	–	–
Morella serrata	–	–	29	–	–	–	–	–	–	–	–	–	–	–
Species group F														
Imperata cylindrica	–	–	–	59	31	17	33	6	–	–	7	–	–	–
Triraphis schinzii	–	–	–	86	25	83	–	6	–	–	5	–	–	–
Mariscus congestus	67	33	–	45	25	17	–	6	–	–	–	4	5	–
Species group G														
Verbena bonariensis	–	–	–	55	38	50	–	12	38	6	9	–	–	–
Conyza bonariensis	–	–	–	21	6	17	50	24	13	–	5	–	3	–
Hibiscus engleri	17	–	14	21	19	–	–	6	29	41	23	23	16	44
Vernonia poskeana	17	–	–	10	–	17	50	24	13	–	7	1	5	–
Species group H														
Schoenoplectus corymbosus	–	33	14	38	38	50	–	18	–	–	–	–	–	–
Sopubia cana	–	–	–	24	6	50	–	–	–	–	5	–	–	–
Species group I														
Andropogon schirensis	17	–	–	17	69	33	–	–	–	–	–	1	–	–
Andropogon eucomus	–	–	14	41	44	17	–	–	8	–	7	–	–	–
Pennisetum macrourum	–	–	14	10	63	–	–	–	–	–	–	–	–	–
Paspalum dilatatum	50	–	–	21	63	–	–	6	–	–	–	–	–	–
Morella serrata	33	–	–	10	50	33	–	–	–	–	–	–	–	–
Eragrostis rotifer	–	–	14	28	50	33	67	–	–	–	2	1	–	–
Species group J														
Miscanthus junceus	–	–	14	3	56	–	–	–	–	–	–	–	–	–
Persicaria lapathifolia	–	–	–	10	31	–	–	6	–	–	–	–	–	–
Fuirena pubescens	17	–	–	3	25	–	–	–	–	–	–	3	–	–
Pseudognaphalium luteo-album	–	–	–	14	31	50	–	–	4	–	21	–	–	–
Buddleja saligna	17	67	–	–	25	–	–	–	–	–	–	–	–	–
Species group K														
Ischaemum fasciculatum	17	–	–	3	6	50	–	–	4	–	–	–	3	–
Andropogon huillensis	–	–	–	17	19	67	–	–	–	–	2	–	–	–
Species group L														
Combretum erythrophyllum	17	33	–	–	–	–	100	100	–	–	–	–	–	–
Diospyros lycioides	17	–	43	14	44	–	83	88	29	12	23	34	35	33
Acacia mearnsii	–	–	29	3	–	–	83	88	8	–	2	–	–	–
Gymnosporia buxifolia	–	67	–	–	–	–	67	71	–	–	2	4	3	–
Bidens pilosa	33	100	–	3	–	–	50	76	13	–	–	13	3	22
Asparagus laricinus	–	100	–	–	–	–	50	59	–	–	–	7	–	–
Panicum maximum	17	–	–	–	–	–	33	71	–	–	2	1	–	–
Celtis africana	33	67	–	–	–	–	67	29	–	–	–	11	–	11
Achyranthes aspera	–	67	–	–	–	–	17	47	–	–	–	4	–	–

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Species group M														
Searsia pyroides	17	33	–	–	6	–	50	6	4	–	–	3	8	–
Cyperus esculentus	17	–	14	69	63	–	100	18	71	–	19	37	16	11
Pentarrhinum insipidum	–	–	–	–	–	–	50	18	4	12	9	1	–	–
Zinnia peruviana	–	–	–	–	–	–	17	12	–	–	2	1	–	–
Artemisia afra	–	–	–	–	–	–	17	6	4	–	–	–	–	–
Ipomoea ommanneyi	–	–	–	–	–	–	17	–	4	–	7	11	19	11
Sporobolus pectinatus	–	–	–	–	–	–	17	–	–	–	9	–	11	–
Species group N														
Eleusine coracana	–	–	–	–	–	–	–	35	–	–	–	–	–	–
Setaria incrassata	–	–	–	–	–	–	17	29	–	–	–	–	–	–
Brachiaria deflexa	–	–	–	–	–	–	17	29	–	–	–	1	–	–
Agathisanthemum bojeri	–	–	–	–	–	–	17	29	17	–	5	4	–	–
Eucalyptus camaldulensis	–	–	–	–	–	–	17	18	4	–	–	–	–	–
Searsia lancea	–	–	–	–	–	–	50	18	–	–	–	7	–	–
Sporobolus fimbriatus	–	–	–	3	–	–	33	18	–	–	–	–	–	–
Salix babylonica	–	–	–	–	–	–	–	18	–	–	–	–	–	–
Sesbania punicea	–	–	–	3	–	–	–	12	–	–	2	–	–	–
Rubus rigidus	33	–	–	3	6	–	17	12	–	–	–	–	–	–
Terminalia sericea	–	–	14	–	–	–	–	12	–	6	–	–	–	–
Chloris virgata	–	–	–	–	–	–	–	12	–	–	–	–	–	–
Eragrostis plana	–	–	–	–	–	–	–	12	4	–	–	–	3	–
Species group O														
Seriphium plumosum	17	–	43	21	38	67	–	–	29	24	63	1	5	11
Eragrostis curvula	–	–	29	3	–	–	17	–	46	94	77	37	49	22
Cynodon dactylon	–	–	–	21	6	–	33	53	63	65	21	3	–	11
Pogonarthria squarrosa	–	–	–	–	–	–	50	12	67	53	26	6	14	11
Perotis patens	–	–	–	–	–	–	33	6	79	100	63	7	14	33
Eragrostis chloromelas	–	–	–	3	–	–	–	6	50	41	33	1	16	33
Richardia brasiliensis	–	–	–	–	–	–	50	24	75	88	56	4	3	22
Aristida stipitata	–	–	–	–	–	–	–	–	42	53	35	9	3	44
Cucumis zeyheri	–	–	–	–	–	–	33	–	42	29	47	3	3	11
Dichapetalum cymosum	–	–	–	–	–	–	–	–	21	53	44	11	16	22
Acanthospermum brasilum	–	–	–	–	–	–	17	18	46	29	19	–	–	11
Elephantorrhiza elephantina	–	–	–	–	–	–	–	6	25	24	63	6	19	22
Tephrosia lupinifolia	–	–	–	–	–	–	–	–	25	41	21	1	–	11
Aristida congesta	–	–	–	–	–	–	–	6	25	24	9	3	3	–
Indigofera oxytropis	–	–	–	–	–	–	–	–	–	47	33	6	8	11
Schizachyrium sanguineum	–	–	–	–	–	–	–	–	25	18	28	9	19	–
Hypochaeris radicata	–	–	–	17	13	50	–	12	46	29	49	3	3	–
Gomphocarpus fruticosus	–	–	–	17	–	17	17	12	13	29	14	1	–	–
Pelargonium dolomiticum	–	–	–	–	–	–	–	–	13	47	9	1	–	–
Aristida diffusa	–	–	–	–	–	–	–	–	17	6	14	–	3	11
Hyparrhenia hirta	–	–	–	–	–	–	–	–	13	12	14	4	5	–
Nemesia fruticans	–	–	–	–	–	–	–	–	25	29	5	3	–	–
Gomphrena celosioides	–	–	–	–	–	–	–	–	21	6	9	1	8	–
Commelina erecta	–	–	–	–	–	–	–	–	–	24	30	1	19	–
Species group P														
Digitaria eriantha	–	–	–	–	–	–	–	12	42	18	7	6	–	–
Schkuhria pinnata	–	–	–	–	–	–	–	24	63	12	7	3	–	22
Trichoneura grandiglumis	–	–	–	–	–	–	–	–	46	35	12	3	3	–
Paspalum scrobiculatum	–	–	–	14	–	17	–	–	29	–	9	–	–	–
Gladiolus species	–	–	–	–	–	–	–	–	13	12	7	1	3	–
Guilleminea densa	–	–	–	–	–	–	–	–	25	–	–	–	–	11
Portulaca quadrifida	–	–	–	–	–	–	–	–	29	–	–	3	3	11
Tribulus terrestris	–	–	–	–	–	–	–	–	25	6	–	–	–	11
Species group Q														
Xanthium strumarium	–	–	–	3	–	–	–	–	21	6	5	1	5	33
Indigofera zeyheri	–	–	–	–	–	–	–	–	17	6	–	1	3	–
Oenothera indecora	–	–	–	–	–	–	–	–	17	–	5	–	–	–

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Cotula australis	–	–	–	–	–	–	–	6	13	–	–	–	3	–
Chamaecrista mimosoides	–	–	–	–	–	–	–	–	13	6	5	–	–	–
Lepidium africanum	–	–	–	–	–	–	–	–	13	6	5	–	3	–
Sonchus dregeanus	–	–	–	–	–	–	–	–	8	6	–	–	–	–
Capsella bursa-pastoris	–	–	–	–	–	–	–	–	13	–	–	–	–	–
Striga elegans	–	–	–	–	–	–	–	–	8	–	2	–	–	–
Thesium utile	–	–	–	–	–	–	–	–	4	6	–	–	3	–
Acalypha villicaulis	–	–	–	–	–	–	–	–	8	–	–	4	–	–
Species group R														
Ochna pulchra	–	–	–	–	–	–	–	–	17	12	16	51	41	44
Chenopodium carinatum	–	–	–	–	–	–	–	–	25	–	2	17	5	11
Species group S														
Burkea africana	–	–	–	–	–	–	–	–	21	41	14	37	19	67
Salacia rehmannii	–	–	–	–	–	–	–	–	4	41	5	10	27	33
Species group T														
Eragrostis racemosa	–	–	–	–	–	–	–	–	–	6	77	1	32	11
Tristachya rehmannii	–	–	–	–	–	–	–	–	4	–	47	4	19	–
Elionurus muticus	–	–	–	–	–	–	–	–	13	12	47	1	11	33
Ocimum obovatum	–	–	–	–	–	–	–	–	–	–	44	6	27	11
Ledebouria ovalifolia	–	–	–	–	–	–	–	–	–	6	37	4	8	–
Eragrostis nindensis	–	–	–	–	–	–	–	–	–	6	40	1	16	–
Coleochloa setifera	–	–	–	–	–	–	–	–	–	12	37	9	3	–
Raphionacme velutina	–	–	–	–	–	–	–	–	4	–	30	1	19	–
Cyperus rupestris	17	–	–	14	6	–	–	–	4	24	37	11	24	11
Protea welwitschii	–	–	–	–	–	–	–	–	–	–	28	–	8	11
Pentanisia angustifolia	–	–	–	–	–	–	–	–	–	–	23	3	19	11
Oxygonum dregeanum	–	–	–	–	–	–	–	–	4	–	23	4	5	11
Digitaria monodactyla	–	–	–	–	–	–	–	–	–	6	26	–	11	–
Campuloclinium macrocephalum	–	–	14	–	–	–	–	–	13	6	21	–	5	11
Chlorophytum cooperi	–	–	–	–	–	–	–	–	–	–	21	4	16	11
Eriosema cordatum	–	–	14	3	–	–	–	–	4	12	26	–	22	11
Hypoxis iridifolia	–	–	–	–	–	–	–	–	–	12	21	1	3	–
Justicia anagalloides	–	–	–	–	–	–	–	–	4	–	21	1	3	–
Felicia muricata	–	–	–	–	–	–	–	–	8	18	21	–	–	–
Helichrysum rugulosum	–	–	–	3	–	–	–	–	17	–	19	1	5	–
Eragrostis capensis	–	–	–	–	–	–	–	–	–	–	16	4	8	–
Crossandra greenstockii	–	–	–	–	–	–	–	–	–	6	16	3	14	–
Nidorella hottentotica	–	–	–	–	–	–	–	–	8	12	23	–	3	–
Zornia linearis	–	–	–	–	–	–	–	–	4	6	14	1	16	–
Chaetacanthus costatus	–	–	–	–	–	–	–	–	–	6	23	3	22	11
Urelytrum agropyroides	–	–	–	–	–	–	–	–	–	–	16	–	14	11
Felicia mossamedensis	–	–	–	–	–	–	–	–	4	–	9	1	3	11
Eragrostis superba	–	–	–	–	–	–	–	–	–	6	9	3	–	–
Crinum graminicola	–	–	–	–	–	–	–	–	–	6	9	–	3	–
Erica drakensbergensis	–	–	–	–	–	–	–	–	–	6	9	–	–	–
Polygala hottentotta	–	–	–	–	–	–	–	–	–	–	7	–	–	–
Kohautia amatymbica	–	–	–	–	–	–	–	–	–	6	7	–	3	–
Lotononis calycina	–	–	–	–	–	–	–	–	–	–	5	–	–	–
Polygala amatymbica	–	–	–	–	–	–	–	–	–	6	5	–	–	–
Species group U														
Ruellia cordata	–	–	–	–	–	–	–	–	–	–	16	14	41	11
Brachiaria serrata	–	–	–	–	–	–	–	–	–	–	37	9	35	–
Lannea edulis	–	–	–	–	–	–	–	–	–	6	9	10	3	22
Species group V														
Kyllinga alba	–	–	–	7	–	–	–	–	8	–	16	1	–	–
Scabiosa columbaria	–	–	–	–	–	–	–	–	13	–	16	–	–	–
Harpochloa falx	–	–	–	–	–	–	–	–	–	6	12	–	–	–
Vernonia oligocephala	–	–	–	–	–	–	–	–	4	–	7	–	–	–
Asclepias glaucophylla	–	–	–	–	–	–	–	–	–	–	5	–	–	–
Raphionacme hirsuta	–	–	–	–	–	–	–	–	–	–	5	–	–	–

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Species group W														
Englerophytum magalismontanum	–	33	–	–	–	–	–	18	–	–	7	86	95	78
Combretum molle	33	–	–	–	–	–	–	6	–	–	7	73	59	44
Canthium gilfillanii	–	–	–	–	–	–	–	–	–	–	5	46	65	11
Selaginella dregei	–	–	–	–	–	–	–	–	–	–	9	41	35	22
Mundulea sericea	–	–	–	3	–	–	–	–	–	–	12	34	76	11
Gymnosporia tenuispina	–	–	–	–	–	–	–	–	–	–	14	50	59	67
Ozoroa paniculosa	–	–	–	–	–	–	–	–	4	–	2	44	19	22
Vangueria infausta	–	–	–	–	–	–	–	–	–	–	2	13	19	–
Raphionacme galpinii	–	–	–	–	–	–	–	–	–	–	14	20	59	22
Strychnos pungens	–	–	–	–	–	–	–	–	–	–	2	14	27	44
Ximenia caffra	–	–	–	–	–	–	–	–	–	–	–	7	27	11
Pavetta zeyheri	–	–	–	–	–	–	–	–	–	–	2	14	27	33
Species group X														
Croton gratissimus	–	–	–	–	–	–	–	–	–	–	–	46	3	33
Elephantorrhiza burkei	–	–	–	–	–	–	–	–	–	–	–	64	16	33
Rhus leptodictya	17	–	14	–	–	–	33	35	21	12	5	56	19	11
Apodytes dimidiata	–	–	–	–	–	–	17	–	–	–	2	33	24	11
Euclea crispa	17	33	–	–	–	–	–	24	4	–	7	49	30	11
Heteropyxis natalensis	–	–	–	–	–	–	17	–	–	–	5	56	3	–
Cymbopogon plurinodis	–	–	–	–	6	–	50	12	13	–	5	39	22	11
Rhoicissus tridentata	–	–	–	–	–	–	–	–	–	–	–	36	11	11
Cussonia paniculata	17	–	–	–	–	–	17	–	–	–	7	37	38	11
Gerbera jamesonii	–	–	–	–	–	–	–	–	–	6	–	36	8	–
Asparagus transvaalensis	–	–	–	–	–	–	–	–	–	–	2	27	16	22
Crassula setulosa	–	–	–	–	–	–	–	–	–	–	–	17	14	–
Species group Y														
Clutia pulchella	–	–	–	–	–	–	–	–	–	–	–	10	5	–
Sutera palustris	–	–	–	–	–	–	–	–	–	–	–	7	–	–
Species group Z														
Vepris reflexa	–	–	–	–	–	–	–	6	–	–	–	6	–	–
Species group AA														
Rhus zeyheri	–	–	–	–	–	–	–	–	4	–	2	20	11	–
Tradescantia species	–	–	–	3	–	–	–	–	8	6	7	13	5	22
Kalanchoe paniculata	–	–	–	–	–	–	–	–	–	–	5	9	5	22
Panicum ecklonii	–	–	14	–	–	–	–	–	–	–	–	9	3	–
Dovyalis zeyheri	–	–	–	–	–	–	–	–	–	–	–	10	–	–
Osyris lanceolata	–	–	–	–	–	–	–	–	–	–	–	10	3	11
Asparagus setaceus	–	–	–	–	–	–	–	–	4	–	2	6	11	–
Opuntia ficus-indica	–	–	–	–	–	–	–	–	–	–	–	6	–	–
Microchloa caffra	–	–	–	–	–	–	–	–	–	–	2	4	–	–
Indigofera spicata	–	–	–	–	–	–	–	–	–	–	5	6	–	–
Athrixia elata	–	–	–	–	–	–	–	–	–	–	–	4	3	–
Drimiopsis burkei	–	–	–	–	–	–	–	–	–	–	–	4	–	–
Asparagus species	–	–	–	–	–	–	–	6	–	–	–	3	3	–
Species group AB														
Brachylaena rotundata	–	–	–	–	–	–	17	–	–	–	–	34	3	–
Maytenus undata	17	–	–	–	–	–	33	6	–	–	–	31	8	–
Faurea saligna	17	33	14	–	–	–	–	–	–	–	–	33	8	–
Dombeya rotundifolia	–	–	–	–	–	–	–	–	4	–	–	27	5	33
Pappea capensis	–	–	–	–	–	–	–	–	4	–	–	24	5	22
Haemanthus humilis	–	33	–	–	–	–	–	–	–	–	2	23	3	–
Combretum collinum	–	–	–	–	–	–	–	–	–	–	–	19	3	11
Diospyros whyteana	17	33	–	–	–	–	–	–	–	–	–	20	–	22
Cyphostemma lanigerum	–	33	–	–	–	–	–	6	–	–	–	24	3	11
Acacia caffra	–	–	–	–	–	–	33	18	–	6	–	13	–	–
Nuxia congesta	–	–	–	–	–	–	–	–	–	–	–	11	3	–
Ficus ingens	–	33	–	–	–	–	–	–	–	–	–	14	–	22

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Species group AC														
Diplorhynchus condylocarpon	–	–	–	–	–	–	–	–	–	–	–	17	3	11
Lannea discolor	–	–	–	–	–	–	–	–	–	–	–	19	3	–
Tragia species	–	–	–	–	–	–	–	–	–	6	–	13	–	22
Hibiscus trionum	–	–	–	–	–	–	–	–	–	–	2	10	8	22
Crassula swaziensis	–	–	–	–	–	–	–	–	–	–	–	10	3	–
Abrus laevigatus	–	–	–	–	–	–	–	12	–	–	2	10	5	–
Lantana camara	–	–	–	–	–	–	–	–	–	–	–	6	3	–
Ipomoea sinensis	–	–	–	–	–	–	–	–	–	6	2	4	–	11
Sphedamnocarpus pruriens	–	–	–	–	–	–	–	–	–	–	2	7	–	22
Species group AD														
Protea caffra	17	–	–	–	–	–	–	–	8	–	9	14	65	–
Lopholaena coriifolia	–	–	–	–	–	–	–	–	–	6	16	3	49	–
Gerbera piloselloides	–	–	–	–	–	–	–	–	–	–	9	7	32	11
Species group AE														
Rhynchosia nitens	–	–	–	–	–	–	–	–	–	–	2	20	22	–
Aloe verecunda	–	–	–	–	–	–	–	–	–	–	–	1	16	–
Phymaspermum athanasioides	–	–	–	3	–	–	–	–	–	–	–	–	11	–
Species group AF														
Hemizygia pretoriae	–	–	–	–	–	–	–	–	–	6	2	3	16	–
Species group AG														
Boophone disticha	–	–	–	–	–	–	–	–	–	6	9	4	11	33
Species group AH														
Eragrostis gummiflua	–	–	71	10	44	17	67	65	33	6	30	27	19	22
Sporobolus africanus	–	–	–	41	25	–	17	65	42	6	14	–	–	11
Species group AI														
Melinis repens	–	–	29	3	31	–	83	47	63	88	81	51	95	56
Themeda triandra	–	–	14	3	13	–	17	12	21	6	93	46	89	11
Tagetes minuta	–	–	14	–	13	–	33	76	50	18	28	66	57	44
Commelina africana	–	–	–	7	19	–	–	18	33	24	63	50	62	33
Asparagus suaveolens	17	–	–	3	–	–	33	24	8	–	51	29	76	22
Ceratotheca triloba	–	–	–	–	–	–	17	6	29	12	–	33	11	33
Solanum incanum	–	–	–	7	–	–	33	12	58	59	33	23	24	22
Species group AJ														
Setaria sphacelata	–	–	–	7	–	33	–	6	42	59	72	63	73	67
Eragrostis trichophora	–	–	–	–	–	–	–	–	33	29	26	30	24	22
Fadogia homblei	–	–	–	–	–	–	–	–	33	65	60	43	81	33
Pollichia campestris	–	–	–	–	–	–	–	–	75	71	49	46	32	67
Fimbristylis hispidula	–	–	–	3	–	–	17	6	58	53	70	44	68	22
Cleome rubella	–	–	–	–	–	–	–	–	67	71	53	30	46	33
Phyllanthus parvulus	–	–	–	–	–	–	–	–	46	88	72	30	65	33
Oldenlandia herbacea	–	–	–	–	–	–	–	–	33	41	81	41	76	67
Heteropogon contortus	–	–	–	–	–	–	–	–	29	29	63	23	14	–
Pellaea calomelanos	–	–	–	–	–	–	17	–	17	35	40	77	86	78
Chamaecrista comosa	–	–	–	–	–	–	–	–	33	76	51	16	57	33
Cleome monophylla	–	–	–	–	–	–	–	–	29	29	19	36	59	33
Pellaea viridis v. viridis	–	–	–	–	–	–	–	–	13	12	35	47	62	67
Cyperus obtusiflorus	–	–	–	–	–	–	–	–	8	65	72	16	41	11
Hypoxis rigidula	–	–	14	7	–	–	17	–	17	6	42	17	51	–
Panicum natalense	–	–	14	–	–	–	–	6	21	18	26	14	30	11
Aristida transvaalensis	–	–	–	–	–	–	–	–	4	–	33	36	46	33
Limeum viscosum	–	–	–	–	–	–	–	–	50	18	14	16	22	33
Phyllanthus maderaspatensis	–	–	–	–	–	–	–	–	13	6	9	1	16	–
Jatropha lagarinthoides	–	–	–	–	–	–	–	–	–	–	12	4	11	11
Species group AK														
Loudetia simplex	–	–	–	–	–	–	–	–	4	–	42	69	97	67
Xerophyta retinervis	–	–	–	–	–	–	–	–	–	–	33	46	92	78
Parinari capensis	–	–	–	–	–	–	–	–	8	18	60	11	57	33

Plant community	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
Number of relevés	**6**	**3**	**7**	**29**	**16**	**6**	**6**	**17**	**24**	**17**	**43**	**70**	**37**	**9**
Rhus magalismontana	–	–	–	–	–	–	17	–	–	–	23	46	86	33
Trachypogon spicatus	–	–	–	–	–	–	–	–	4	6	35	40	54	44
Lotononis eriantha	–	–	–	–	–	–	–	–	4	6	30	3	59	11
Diheteropogon amplectens	33	–	14	–	–	–	17	–	13	12	35	37	68	44
Zantedeschia rehmannii	–	–	–	–	–	–	–	–	–	–	19	59	86	56
Tristachya leucothrix	–	–	–	–	–	–	–	–	–	–	14	13	59	44
Senecio oxyriifolius	–	–	–	–	–	–	–	–	–	–	14	27	59	22
Senecio venosus	–	–	–	–	–	–	–	–	–	–	21	19	43	11
Zanthoxylum capense	–	–	–	–	–	–	–	–	8	12	9	29	41	–
Rhynchosia monophylla	–	–	–	–	–	–	33	–	–	–	30	10	35	22
Acalypha angustata	–	–	–	7	–	–	–	–	8	6	16	6	41	11
Melinis nerviglumis	–	–	–	–	–	–	–	–	8	–	12	26	16	11
Sphenostylis angustifolia	–	–	–	–	–	–	17	–	8	–	19	7	43	–
Cyanotis speciosa	–	–	–	–	–	–	–	–	4	–	30	7	57	11
Ancylobotrys capensis	–	–	–	–	–	–	–	–	–	–	7	31	57	33
Indigofera melanadenia	–	–	–	–	–	–	–	–	–	–	9	17	30	–
Bewsia biflora	–	–	–	–	–	–	–	–	–	12	19	4	22	11
Species group AL														
Setaria lindenbergiana	–	–	–	–	–	–	–	–	4	–	21	73	54	56
Commelina benghalensis	–	–	–	–	–	–	–	–	–	–	5	59	62	56
Cryptolepis oblongifolia	17	–	–	–	–	–	–	–	–	–	9	20	27	–
Thunbergia atriplicifolia	–	–	–	–	–	–	–	–	4	–	9	4	19	–
Vernonia hirsuta	–	–	–	3	–	–	–	–	–	6	5	–	5	–

1.2 *Cyathea dregei–Ilex mitis–Celtis africana* woodland sub-community

Vegetation description: This sub-community is characterised by the presence of the forb *Plectranthus hereroensis* (species group C). The tree *Cyathea dregei* is dominant in this plant sub-community (species group A). Constantly present species in the sub-community are the shrub *Asparagus laricinus* (species group L) and the forb *Plectranthus hereroensis* (species group C). The tree *Celtis africana* (species group L) is locally prominent in the sub-community. The grass *Paspalum urvillei* (species group D) is prominent in the plant sub-community. The shrub *Diospyros whyteana* (species group AB) is locally prominent.

2. *Paspalum urvillei–Phragmites australis* valley bottom wetland

Locality and habitat: This plant community is located on the lower-lying valley bottom sections of Telperion and is represented by 58 sample plots. The altitude varies between 1249 and 1444 m a.s.l. This community is found on sandy clay soil with low rock cover (covering <4%) in some areas and high rock cover (90%) in others. The area comprises valley bottom wetlands, perennial streas, and drainage lines with gentle slopes with a gradient of 1° to 5°. The average number of different plant species recorded for this community was 12.

Vegetation description: The diagnostic species for this community is *Plectranthus hereroensis* (species group C). Constant species include *Phragmites australis* (species group D) and Eragrostis *gummiflua* (species group AH). This community is characterised by the presence of species from species group D and includes the grasses *Phragmites australis*, *Paspalum urvillei* and the forbs *Thelypteris confluens* and *Typha capensis*. The vegetation is dominated by the reed *Phragmites australis* (species group D), which occurs constantly throughout the plant community.

This wetland community is in some areas characterised by the local dominance of the alien invasive tree *Populus × canescens* (species group E), while the dwarf shrub *Seriphium plumosum* (species group O) and *Verbena bonariensis* (species group G) are constantly present, although prominent in isolated localities. The estimated grass cover for this community varies between 70% and 95%, with an average of 78% and the forbs between 20% and 40% with an average of 25%.

Most of this community has high wildlife activity, with visible sleeping and drinking sites. On many occasions animals were observed grazing in this plant community. Animal trampling paths and sleeping sites together with dung was also noted in this community and resulted in some areas having slight erosion. No outcrops or large rocks were present in the area. Accessibility of fire in this plant community ranges from easy to difficult. This community is divided into four sub-communities.

2.1 *Paspalum urvillei–Phragmites australis–Populus × canescens* woodland

Locality and habitat: This sub-community is represented by seven relevés and is located in the central and eastern section of Telperion. The altitude for this sub-community varies between 1249 and 1331 m a.s.l.

Vegetation description: Characteristic species for this sub-community are from species group E, and include the trees *Populus × canescens* and *Myrica serrata*.

Dominant species in the sub-community are the alien invasive tree *Populus* × *canescens* (species group E) and the reed *Phragmites australis* (species group D). Other woody species found in the sub-community include the shrub *Diospyros lycioides* (species group L) and the dwarf shrub *Seriphium plumosum* (species group O). The grass *Eragrostis gummiflua* (species group AH) has a high constancy in this sub-community.

2.2 *Paspalum urvillei–Phragmites australis–Imperata cylindrica* sub-community

Locality and habitat: This sub-community is represented by 28 relevés and occurs mostly on the north, west and south–west facing banks of streams and wetland areas. Altitude ranges between 1286 and 1444 m a.s.l.

Vegetation description: The characteristic plant species for this plant sub-community are from species group F, and includes *Imperata cylindrica*, *Triraphis schinzii* and *Mariscus congestus*. The vegetation is dominated by the reed *Phragmites australis* (species group D), while the grass *Imperata cylindrica* (species group F) is co-dominant.

Due to the high floristic variation in this sub-community two variants could be derived from the sub-community.

Verbena bonariensis variant

Species from species group G are characteristic for this variant and the vegetation is dominated by the grasses *Imperata cylindrica* (species group F) and *Phragmites australis* (species group D).

Schoenoplectus corymbosus variant

This variant is characterised by permanently wet wetland areas and species from species group H. The vegetation is dominated by the grass *Phragmites australis* (species group D) with *Schoenoplectus corymbosus* (species group H) being prominent.

2.3 *Paspalum urvillei–Phragmites australis–Miscanthus junceus* sub-community

Locality and habitat: This sub-community comprises 16 relevés. It is located in the central, southern and the north–western sections of the study area. It is found in adjacent to seepage lines in the reserve at altitudes ranging from 1292 to 1425 m a.s.l.

Vegetation description: Characteristic plant species for this sub-community are from species group J, and include: *Miscanthus junceus*, *Persicaria lapathifolia*, *Fuirena pubescens*, *Pseudognaphalium luteo–album* and *Buddleja saligna*. The vegetation is dominated by the forb *Miscanthus junceus* (species group J), while the reed *Phragmites australis* (species group D) is co-dominant. The grass *Pennisetum macrourum* (species group I), the forb *Pteridium aquilinum* (species group B) and the dwarf shrub *Seriphium plumosum* (species group O) are locally prominent. This area shows signs of trampling and visible wildlife drinking sites are present.

2.4 *Paspalum urvillei–Phragmites australis–Ischaemum fasciculatum* sub-community

Locality and habitat: A total of six sample plots represent this sub-community which is located in the northern part of the study area on north and southwest facing slopes. Altitude ranges from 1321 to 1431 m a.s.l.

Vegetation description: This sub-community is characterised by plant species from species group K, which include the grasses *Ischaemum fasciculatum* and *Andropogon huillensis*. There are no dominant species, however the grass *Ischaemum fasciculatum* is locally prominent. Other species with a high constancy in this sub-community are the dwarf shrub *Seriphium plumosum* (species group O), the grasses *Triraphis schinzii* (species group F), *Schoenoplectus corymbosus* (species group H), and the forbs *Verbena bonariensis* (species group G), *Sopubia cana* (species group H), *Pseudognaphalium luteo–album* (species group J) and *Hypochaeris radicata* (species group O).

3. *Diospyros lycioides–Combretum erythrophyllum* riparian woodland

Locality and habitat: This plant community is found along the Wilge River and consists of 23 relevés, with an average of 21 different plant species recorded per sample plot. It is found on the northern and western boundary of Telperion with a small section in the south–eastern part. The altitude varies between 1228 and 1436 m a.s.l. The woodland consists of riverine areas with moderate to steep slopes that vary between 2° and 40°. Medium-sized rocks cover between 0% and 70% of the plant community, with an average of 9%. The soil is predominantly clay with some sand in sections.

Vegetation description: Constant species in this community include *Acacia mearnsii* (declared alien invader) and *Combretum erythrophyllum* (species group L). Characteristic plant species in this plant community also include species from species group L. Although no dominant species were statistically determined at the set levels, the vegetation is dominated by the trees *Combretum erythrophyllum*, *Diospyros lycioides* and the declared alien invasive tree *Acacia mearnsii* (species group L). The reed *Phragmites australis* (species group D) is prominent throughout the community, while the grasses *Melinis repens* (species group AI), *Eragrostis gummiflua* (species group AH) and the forb *Tagetes minuta* (species group AI) are present throughout this community.

Estimated tree cover ranges from 0% to 95%, with an average of 46%. The shrub layer covers between 0% and 59% of the plant community, with an average of 13%. Grasses cover between 0% and 65% with an average of 18% while the forb cover varies between 8% and 15% with an average of 12%.

This plant community is easily accessible to wildlife. Signs of wildlife activity include visibly grazed areas, foot paths, and the presence of dung. Soil erosion was noted in some parts of the community especially along the river-bank areas where occasional flooding occurs.

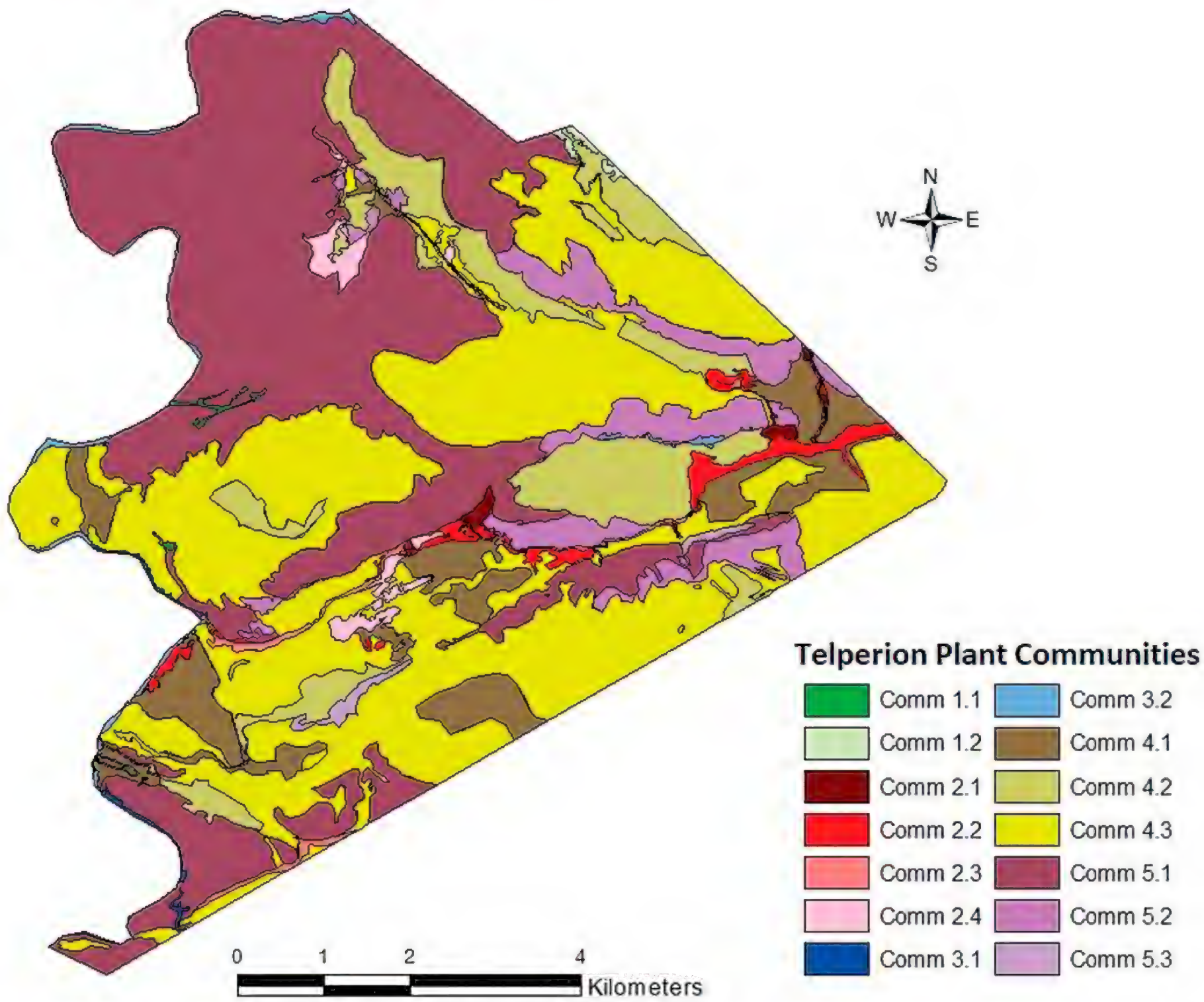

Figure 2. Vegetation map for Telperion Nature Reserve indicating the different plant communities identified during this study.

Alien plant species that were recorded in this community include *Acacia mearnsii* (species group L), *Populus* × *canescens* (species group E) and *Verbena bonariensis*. Pioneer species *Conyza bonariensis*, *Hibiscus engleri* and *Vernonia poskeana* (species group G) and *Solanum incanum* (species group AI) are present along the eroded areas of the Wilge rivers embankments. This community is divided into two sub-communities.

3.1 *Diospyros lycioides–Combretum erythrophyllum–Searsia pyroides* sub-community

Locality and habitat: This sub-community is represented by six relevés and occurs in a mosaic distribution interspersed with sub-community 3.2. The altitude ranges from between 1291 and 1286 m a.s.l.

Vegetation description: Species from species group M are characteristic for this sub-community. The vegetation in this sub-community is dominated by the trees *Celtis africana*, *Combretum erythrophyllum* and *Acacia mearnsii* (species group L), while the presence of the tree *Searsia pyroides* (species group M) is characteristic. Constant species throughout the sub-community are *Cyperus esculentus* (species group M), and *Melinis repens* (species group AI).

3.2 *Diospyros lycioides–Combretum erythrophyllum–Searsia lancea* sub-community

Locality and habitat: This sub-community consists of 17 relevés with altitude ranging between 1228 and 1436 m a.s.l.

Vegetation description: This sub-community is characterised by the presence of species from species group N. The trees *Combretum erythrophyllum* and *Acacia mearnsii* (species group L) dominate the vegetation. Prominent species include the tree *Searsia leptodictya* (species group X), and the grasses *Cynodon dactylon* (species group O), and *Sporobolus africanus* (species group AH). Constant species in the plant sub-community include *Bidens pilosa*, *Diospyros lycioides*, *Gymnosporia buxifolia*, *Panicum maximum* (species group L), *Phragmites australis* (species group D) and *Tagetes minuta (AH)*.

The alien invader tree *Populus* × *canescens* (species group E) is locally prominent where it has displaced most of the native plant species.

4. *Eragrostis curvula–Seriphium plumosum* mid plateau grassland

Locality and habitat: This plant community, which is the largest of all the communities, is located throughout the reserve where it is associated with the plateau and mid-plateau areas. The topography of the area is mostly level to slightly undulating with gentile slopes ranging from 1° to 5°. Altitude ranges between 1290 and 1485 m a.s.l. Rock cover is sparse and averages 10%. Soils are a combination of deep red sandy soils in some areas, and shallow rocky soil in other areas.

Vegetation description: Diagnostic species include *Portulaca quadrifida* and *Tribulus terrestris* (species group P). Constant species include *Acanthospermum brasilum*, *Cynodon dactylon* (species group O), *Cleome rubella* and *Pollichia campestris* (species group AJ). Species from species group O area characteristic. The vegetation is dominated by the grasses *Eragrostis curvula*, *Cynodon dactylon*, and *Eragrostis chloromelas* (species group O), the naturalised weed *Schkuhria pinnata* (species group P), and the dwarf shrub *Seriphium plumosum* (species group O) that is locally dominant. Other prominent species in the community include the dwarf shrub *Elephantorrhiza elephantina* (species group O), the grasses *Melinis repens* (species group AI), *Setaria sphacelata* (species group AJ), and the forbs *Dichapetalum cymosum*, and *Hypochaeris radicata* (species group O).

Estimated tree cover ranges between 0% and 95%, with an average of 13%, while the shrub layer cover ranges from 0% to 95%, with an average of 9%. The grasses cover is between 5% and 95%, with an average of 50%. Forb cover ranges between 0% and 40%, with an average of 9%.

Wildlife activity is noticeable in this plant community that is characterised by old crop fields with remnants of old farming equipment found in a few of the sampling plots. In some sites there is visible densification of *Seriphium plumosum* (species group O), while in other sites this species is dominant. The area is easily accessible to animals resulting in trampling, visible animal paths and discernible overgrazing in some sections. Soil erosion and several bare patches on the ground were noted, while many old termite mounds and animal dens were present in the plant community. This community is divided into three sub-communities.

4.1 *Eragrostis curvula–Seriphium plumosum–Digitaria eriantha* grassland sub-community

Locality and habitat: This sub-community is represented by 24 relevés and occurs mostly in the southern and western parts of Telperion. This grassland sub-community is elevated at an altitude between 1290 and 1406 m a.s.l.

Vegetation description: This grassland sub-community is characterised by the presence of species from species group P. The vegetation is dominated by the grasses *Perotis patens* and *Eragrostis chloromelas* (species group P) while the grasses *Melinis repens* (species group AI), *Heteropogon contortus* and *Eragrostis trichophora* (species group AJ) are prominent. This sub-community has two variants within it.

Indigofera zeyheri variant

This variant is characterised by species from species group Q and is dominated by the grass *Digitaria eriantha* (species group P) and sections by the fern *Pteridium aquilinum* (species group B).

Ochna pulchra variant

This variant is characterised by species from species group R and is dominated by the grasses *Eragrostis curvula* and *Cynodon dactylon* (species group O), while the tree *Burkea africana* (species group S) is dominant in sections.

4.2 *Eragrostis curvula–Seriphium plumosum–Burkea africana* woodland sub-community

Locality and habitat: This sub-community is represented by 17 relevés and occurs mostly in the southern and central parts of Telperion at altitudes that range between 1331 and 1463 m a.s.l.

Vegetation description: Species from species group S are characteristic of this plant sub-community and include the tree *Burkea africana* and the forb *Salacia rehmannii*. The vegetation is dominated by the grass *Eragrostis curvula* (species group O) while the prominence of *Burkea africana trees* (group S) and the grasses *Cynodon dactylon* (species group O) and *Setaria sphacelata* (species group AJ) are characteristic.

4.3 *Eragrostis curvula–Seriphium plumosum–Eragrostis racemosa* grassland sub-community

Locality and habitat: This sub-community is represented by 44 relevés and is found in the south–western section of Telperion. Altitude ranges between 1290 and 1495 m a.s.l.

Vegetation description: Plant species from species group T are characteristic for this plant sub-community. The vegetation is dominated by the dwarf shrub *Seriphium plumosum* and the grasses *Eragrostis curvula* (species group O), *Eragrostis racemosa* (species group T), and *Themeda triandra* (species group AI). Prominent species include the grasses *Tristachya rehmannii* (species group T), *Melinis repens* (species group AI), *Setaria sphacelata* and the forb *Fadogia homblei* (species group AJ). Three variants were present for this plant sub-community.

Typicum variant

This variant is characterised by the absence of species from species groups U and V and is dominated by the dwarf shrub *Seriphium plumosum* and the grasses *Eragrostis curvula* (species group O) and *Eragrostis gummiflua* (species group AH).

Loudetia simplex variant

This variant is characterised by the presence of species from species group U. The vegetation is dominated by the grass *Loudetia simplex* and the forbs *Xerophyta retinervis* (species group AK).

Setaria sphacelata variant

This variant is characterised by species from species group V and the vegetation is dominated by the grasses *Setaria sphacelata* (species group AJ) and *Themeda triandra* (species group AI).

5. *Combretum molle–Englerophytum magalismontanum* rocky ridge woodland

Locality and habitat: This plant community, which is the second largest community, occurs on the rocky ridges of Telperion and is represented by 115 relevés. An average of 43 plant species were recorded per sample plot. Altitude ranges between 1280 and 1523 m a.s.l with shallow rocky to loamy soil. These rocky ridges have a high rock cover with an average of 69%.

Vegetation description: Constant species for this plant community include *Englerophytum magalismontanum*, *Combretum molle*, *Pellaea calomelanos*, *Themeda triandra* and *Xerophyta retinervis*. This community is characterised by the presence of species from species group W. The woody layer is dominated by *Englerophytum magalismontanum* and *Combretum molle* (species group W) while the grass layer is dominated by *Loudetia simplex* (species group AK).

The woody layer has an average cover of 53%, while the shrub layer cover is 24%. The grass layer is estimated to cover between 5% and 90%, with an average of 38%, while the forbs cover between 0% and 65% with an average of 25%.

Animal activity was observed in some parts of this community. A few termite mounds, moribund grasses and patched of bare soil were also observed. This community is divided into three sub-communities.

5.1 *Combretum molle–Englerophytum magalismontanum–Croton gratissimus* woodland

Locality and habitat: This plant sub-community is represented by 69 relevés. The largest part of this woodland is located in the northern section of the reserve with smaller areas present in the southern and western parts. The altitude of this sub-community ranges from 1280 to 1454 m a.s.l.

Vegetation description: Species from species group X are characteristic for this sub-community. The vegetation is dominated by the woody species *Croton gratissimus*, *Elephantorrhiza burkei* (species group X), *Englerophytum magalismontanum* and *Combretum molle* (species group W), with the grass *Melinis repens* (species group AI) present throughout the sub-community. The forb *Haemanthus humilis* (species group AB) is restricted to this plant sub-community. This sub-community has four variants.

Clutia pulchella variant

This variant is characterised by the presence of species from species group Y with the small shrub *Clutia pulchella* (species group Y), the grass *Eragrostis gummiflua* (species group AH), and the forb *Cyperus esculentus* (species group M) being prominent.

Vepris reflexa variant

This variant is characterised by the presence of the trees *Vepris reflexa* (species group Z), *Strychnos pungens* (species group W) and *Burkea africana* (species group S).

Brachylaena rotundata variant

This variant is characterised by the presence of species from species group AA. The vegetation is dominated by the tree *Brachylaena rotundata* (species group AB) and the grass *Loudetia simplex* (species group AK).

Diplorhynchus condylocarpon variant

This variant is characterised by the presence of species from species group AC and the near absence of species from species group AB. The vegetation is dominated by the tree *Diplorhynchus condylocarpon* (species group AC) and the grass *Setaria lindenbergiana* (species group AL).

5.2 *Combretum molle–Englerophytum magalismontanum–Protea caffra* woodland

Locality and habitat: This plant community is represented by 37 relevés. It occurs in the southern and eastern steep midslope sections of the rocky ridges of Telperion with an altitude ranging between 1343 and 1523 m a.s.l.

Vegetation description: Characteristic plant species for this plant sub-community are species from species group AD. The woody layer is dominated by the tree *Protea caffra*, the small shrub *Lopholaena coriifolia* (species group AD), *Combretum molle*, and *Englerophytum magalismontanum (species group W)*, while the herbaceous layer is dominated by the grasses *Melinis repens* (species AH) and *Loudetia simplex* (species group AK). This sub-community has two variants within it.

Rhynchosia nitens variant

This variant is characterised by the presence of species from species group AE with the shrub *Rhynchosia nitens* being prominent.

Ocimum obovatum variant

This variant is characterised by the presence of the forb *Hemizygia pretoriae* from species group AF.

5.3 *Combretum molle–Englerophytum magalismontanum–Boophone disticha* woodland

Locality and habitat: This plant sub-community is represented by nine sample plots. It occurs in the south–western section of the reserve. The altitude of this sub-community ranges from 1341 to 1412 m a.s.l.

Vegetation description: The forb *Boophone disticha* (species group AG) is the only characteristic plant species for this subcommunity. The tree *Burkea africana* (species group S) and the grass *Loudetia simplex* (species group AK) dominate the woody and herbaceous layers respectively.

Species richness and diversity

Plant communities 4.3, 5.1 and 5.2 had the highest species richness. This is also reflected in Margalef's index (Fig. 3). All three communities also had the highest effective number of species diversity (Fig. 4). Diversity (the number of species and their abundance) comparisons were done for the various plant communities using a Kruskal-Wallis ANOVA. Results showed that there were significant differences between the various communities (Kruskal-Wallis: $X^2_2 = 754.1$, n_1 to $n_{14} = 271$, $P < 0.05$). A Dunn's post hoc test was done to see which specific communities differ significantly in terms of diversity, findings indicate that 79% (n = 72) of 91 possible community combinations were significant (Table 2).

Discussion

Plant communities

This study resulted in the identification and description of 22 different plant communities that are grouped into five major communities. Grasslands dominate the largest sections of Telperion.

The *Alsophila dregei–Ilex mites* ravine woodland (community 1) is the smallest community (18 ha - 0.3% of the total area) and is typical of rocky ravine areas occurring on cool moist steep rocky midslopes and scarps that are mostly south facing, although some areas are north facing. The dominant woody species *Alsophila dregei*, *Ilex mites*, *Halleria lucida* and the grass *Paspalum urvillei* are all indicative of permanently moist conditions as is the case in kloof areas (Palgrave 2002; Van Oudtshoorn 2012). The alien invasive shrub *Rubus rigidus* forms dense patches in sections where it has displaced the native vegetation and poses a threat to the native species.

A large proportion of the lower-lying areas of Telperion belong to the *Paspalum urvillei–Phragmites australis* valley bottom wetland community (community 2) that comprises 266 ha (3.6% of the total area) and is associated with clay soil. This community is located adjacent to streams, tributaries and seepage areas that are either permanently or seasonally wet. This community consists of four sub-communities (one with two variants).

All the sub-communities except sub-community 2.1 are dominated by natural species. Sub-community 2.1 is characterised by the dominance of the alien invasive tree *Populus × canescens* that forms dense stands where the natural vegetation has mostly been displaced. Sub-communities 2.2, 2.3 and 2.4 contain natural vegetation and are typical of permanently and seasonally wet areas. Sub-community 2.2 consists of two variants. The *Verbena bonariensis* variant (2.2.1) that occurs along the edge of the wetland on seasonally wet areas and shows affinity in terms of plant species composition with the *Imperata cylindrica* seepage wetland described by Swanepoel (2006) in the adjacent Ezemvelo Nature Reserve, with both areas characterised by the prominence of the grasses *Imperata cylindrica* and *Paspalum urvillei*. The sedge dominated *Schoenoplectus corymbosus* variant (2.2.2) is found in permanently wet pools and dams. These variants are

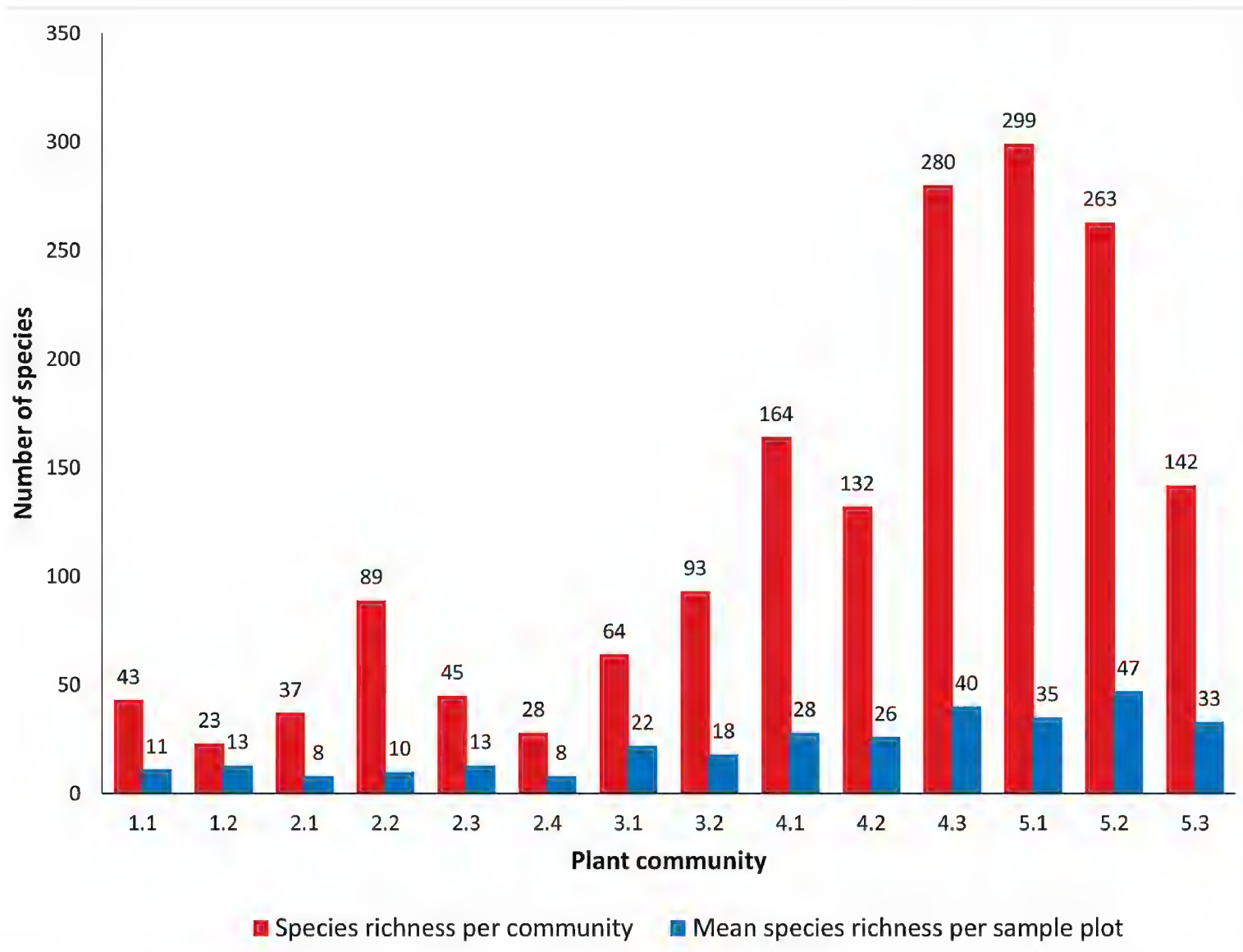

Figure 3. Species richness for the different plant communities of Telperion Nature Reserve. Species richness per plant community: the total number of species recorded for the community in all sample plots. Mean species richness per sample plot: the mean number of species recorded for the various sample plots (100 m²) in each community.

Table 2. Dunn's post hoc test results indicating significant and non-significant differences in diversity (the number of species and their abundance) between the various plant communities present on Telperion Nature Reserve. Cells highlighted in pink show significant differences between the plant communities.

Plant Comms	1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	4.1	4.2	4.3	5.1	5.2	5.3
1.1		0.28	0.58	0.02	0.34	0.35	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.2			0.60	0.00	0.04	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.1				0.00	0.13	0.70	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.2					0.18	0.00	0.68	0.21	0.00	0.00	0.00	0.00	0.00	0.00
2.3						0.06	0.35	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2.4							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.1								0.10	0.00	0.00	0.00	0.00	0.00	0.00
3.2									0.00	0.00	0.00	0.00	0.00	0.00
4.1										0.02	0.00	0.00	0.00	0.12
4.2											0.00	0.00	0.00	0.42
4.3												0.07	0.48	0.00
5.1													0.01	0.00
5.2														0.00
5.3														

Cells highlighted in pink indicate signifant differences ($P < 0.05$) between plant communities.

common in wetland areas as described by Swanepoel (2006) in Ezemvelo Nature Reserve, namely the *Schoenoplectus corymbosus* wetland, as well as in bushveld areas where a similar community was described by Filmalter (2010) for a wetland in the Loskopdam Nature Reserve, namely the *Schoenoplectus corymbosus–Juncus species* sub-community. Sub-communities 2.3 and 2.4 are large reed beds that occur in the permanently wet streams and wetlands throughout the study area. Both these communities are characterised by the prominence of the tall reed *Phragmites australis*, the grass *Eragrostis rotifer* and the fern *Thelypteris confluens*. These sub-community are similar in habitat and species composition to the *Phragmites australis–Thelypteris confluens* tall dense wetland described in Ezemvelo Nature Reserve by Swanepoel (2006).

The *Diospyros lycioides–Combretum erythrophyllum* riparian woodland (community 3) is found on the north, north–west, and west of Telperion and is associated with the Wilge River and associated streams. This plant community is dominated by the tree *Combretum erythrophyllum* and in localized areas by the alien invader tree *Acacia mearnsii*, and consists of two sub-communities. Sub-community 3.1 is less disturbed with few alien invader and pioneer weed species; whereas community 3.2 comprises sections where alien invader species such as the trees *Acacia mearnsii*, *Eucalyptus camaldulensis*, *Sesbania punicea* and *Populus alba* are dominant. The pioneer weed species *Bidens pilosa* and *Tagetes minuta* are constant throughout both sub-communities indicating some levels of disturbance through animal activity and regular floods.

Riparian vegetation plays an important role in the improvement of water quality in rivers. The vegetation protects streams from external pollutants that end up in rivers, thereby improving overall water quality (Dosskey et al. 2010). Plant community 3 shows little to no erosion which can be attributed to the riparian vegetation that binds and stabilises the clay, sandy soils along the river embankments. Large trees such as *Combretum erythrophyllum*, *Celtis africana* and even in this case, the alien invader *Acacia mearnsii*, are valuable in stabilising river channels and embankments (Dosskey et al. 2010).

The *Eragrostis curvula–Seriphium plumosum* mid-plateau grassland (community 4) comprises 58% (4,267 ha) of the reserve and is the largest plant community. Large sections of these midslope plateau areas have in the past been used for cultivation, planting of pasture grasses, and grazing. Since being incorporated into Telperion, these areas have been left fallow and left to recover naturally from previous disturbance. Exposure to grazing and browsing by ungulates is however allowed. In some areas the effects of past overgrazing and cultivation are still evident with the secondary successional grass *Eragrostis curvula* and the indigenous encroacher species *Seriphium plumosum* dominating the vegetation. In other areas that have not been affected by previous agricultural practices palatable grasses such as *Themeda triandra*, *Digitaria eriantha*, and *Setaria sphacelata* are prominent. Plant community 4 comprises three sub-communities with their respective variants.

The *Eragrostis curvula–Seriphium plumosum–Digitaria eriantha* grassland (sub-community 4.1) and its two variants are characterised by deep red loamy soil with high grass cover. The grass layer is well developed and dominated by the palatable grass *Digitaria eriantha*. As a result of being well developed, this sub-community is utilised by many large ungulates, resulting in localised trampling and the grasses being grazed short. In local overgrazed sections the pioneer grass *Cynodon dactylon* and the secondary successional *Eragrostis chloromelas* have established due to continued grazing by animals such as black wildebeest and blesbok.

The *Eragrostis curvula-Seriphium plumosum–Burkea africana* woodland (sub-community 4.2) occurs on deep sandy soil on the midslope plateau areas as large woodland patches dominated by the tree *Burkea africana*. Termite mounds are found in this sub-community. *Burkea africana* normally grows in homogeneous clumps or may be accompanied by other tree species such as *Lannea discolour*,

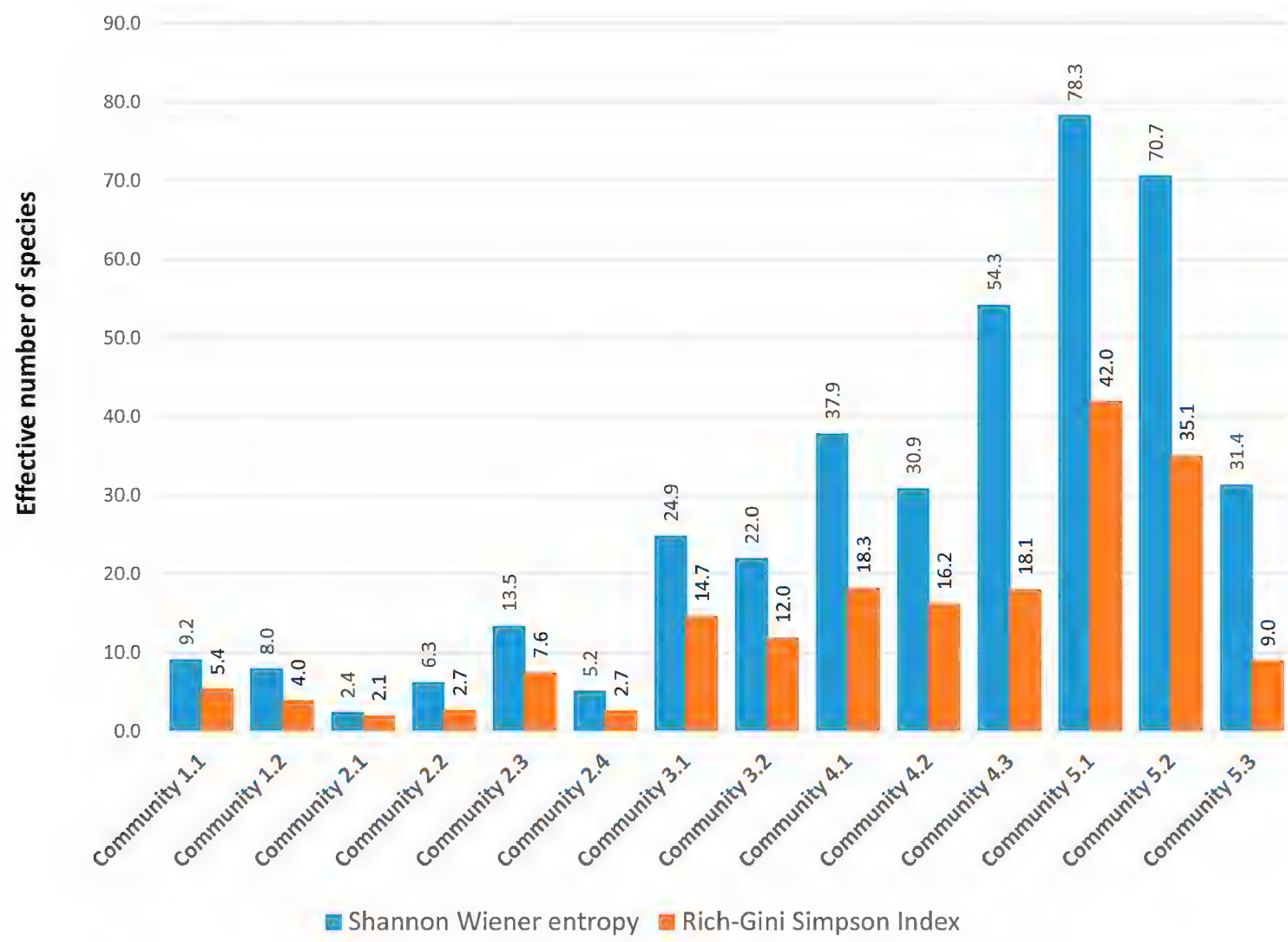

Figure 4. Shannon-Wiener Index and Rich-Gini-Simpson Index effective number of species values for the different plant communities for Telperion Nature Reserve.

Ochna pulchra, and the shrub *Elephantorrhiza burkei*. This sub-community shows signs of previous overgrazing or disturbance hence the dominance of the secondary successional grass *Eragrostis curvula*. Localised overgrazing could have resulted in the establishment of the *Burkea africana* patches. Nemadodzi et al. (2020) studied suitable growing conditions and found that these trees grow better in red sandy soil with modest water. *Burkea africana* has a shallow well-developed lateral root system (Rutherford 1983) that allows it to absorb water and nutrients efficiently. These trees can be regenerated through animal scarring (particularly by porcupines), fires and windstorms (Wilson and Witkowski 2003). *Burkea africana* trees growing in large woody patches can be explained by the populations' size stricture. According to Wilson and Witkowski (2003); these patches demonstrate that previous demographic events had a role to play in predicting the future demographics of the population. In some areas many sprouting trees are present that indicate disturbance (Walker et al. 1986). This could be due to localised overgrazing, fire or animal activity by for example porcupines (Wilson and Witkowski 2003). This sub-community is similar to that found by Nkosi et al. (2016) in the Bankenveld areas of Loskopdam Nature Reserve and was described under the *Setaria sphacelata–Lannea discolor* open woodland community. Apart from similar woody species sub-community 4.2 and the community described by Nkosi et al. (2016) also share common grass species such as *Cynodon dactylon* and *Eragrostis curvula*, and characteristic forb species such as *Gladiolus* species and *Schkuhria pinnata*.

The *Eragrostis curvula-Seriphium plumosum–Eragrostis racemosa* grassland (sub community 4.3) also occurs on deeper sandy to loam soils. Large portions of this sub-community have been cultivated and are characterised by dense stands of *Seriphium plumosum* where most of the natural grass species have been displaced. This encroacher species is known to decrease grazing capacity up to 80% in grasslands. Although *Seriphium plumosum* thrives in overgrazed areas, many other factors also contribute to its flourishing, including, but are not limited to the slope of the area in which it is found, the altitude, soil pH and soil fertility (Snyman 2006). This dwarf shrub is not usually found in wet, clay areas that are fertile (Snyman 2006). However, some wet areas in the reserve do have some *Seriphium plumosum* encroaching into them (e.g. sub-community 2.1). *Seriphium plumosum* not only reduces the grazing capacity of plant communities, but also contributes to the decrease in biodiversity of a plant community (Singh et al. 2003; Smit 2004). There are however sections within this community where the vegetation is dominated by the palatable climax grass *Themeda triandra* with only a few individuals of *Seriphium plumosum* present.

The *Combretum molle–Englerophytum magalismontanum* rocky woodland (plant community 5) is the second largest plant community on Telperion (2796 ha - 38% of the total area) and is found on gentle to steep midslopes of the rocky ridges and hills on the reserve. This community is associated with shallow, gravely soils and high rock cover. The woody layer is strongly characterised by the dominance/prominence of the trees *Englerophytum magalismontanum* and *Combretum molle*. Animal access into the community ranges from easy to difficult with the very steep areas avoided by ungulates. This community has three natural sub-communities, (5.1 with four variants, 5.2 with two variants and 5.3 with no variants).

Sub-community 5.1 is located mostly on the higher-lying warm, dry, north facing slopes of Telperion and is very rocky, with an average rock cover of 71%. The herbaceous layer is sparse due to the high rock cover. Animal activity is noticeable in this sub-community and there are signs of trampling, animal dung and sleeping sites. Baboons, giraffes, various small mammals and porcupines were observed in this sub-community during the vegetation surveys. This sub-community is similar to the *Burkea africana–Ochna pulchra–Croton gratissimus* North-facing Slope Woodland as described by Swanepoel (2006) in the adjacent Ezemvelo Nature Reserve, and the *Ochna pulchra–Englerophytum magalismontanum* Warm Temperate Mountain Bushveld of the Bankenveld as described by Bredenkamp and Brown (2003).

The *Combretum molle–Englerophytum magalismontanum–Protea caffra* woodland (sub-community 5.2) is found on shallow soils of south facing slopes with an average rock cover of 67%. Adie et al. (2011) found that regular fires suppressed *Protea caffra* regeneration and caused greater adult mortality in grassland areas. The high rock cover within this sub-community protects *Protea caffra* shrubs and seeds against fire, resulting in the dominance of this species on the southern slopes of the reserve. This sub-community is similar to the *Loudetia simplex–Protea caffra* South-facing Open Shrubland described by Swanepoel (2006) in Ezemvelo Nature Reserve and the *Setaria sphacelata–Lannea discolour–Englerophytum magalismontanum* sub-community described by Nkosi (2014) in the Loskopdam Nature Reserve. Sub-community 5.2 falls within the broader *Tristachya biseriata-Protea caffra* Cool Temperate Mountain Bushveld of the Bankenveld as described by Bredenkamp and Brown (2003).

The *Combretum molle–Englerophytum magalismontanum–Boophone disticha* woodland (sub-community 5.3) is dominated by the tree species *Burkea africana* and the grass species *Loudetia simplex*. This sub-community is characterised by the presence of the protected geophyte *Boophone disticha* that occurs between the flat rock sheets in open areas.

Species richness and diversity

Sub-communities 5.1 and 5.2 had the highest species richness and diversity These communities are located on the rocky ridges with varying slopes and altitudes as well as rock cover. This creates excellent condition for microhabitats where a variety of species can establish (Brown and Bezuidenhout 2018). This was evident with various geophytic plant species such as *Haemanthus humilis*, *Xerophyta retinervis*, *Crassula setosa* and *Zantedeschia rehmannii* present in moist–dry rock crevices shaded by the trees and shrubs. The shade of the trees and shrubs that vary in cover also provide microhabitats as well as protecting the grasses from being grazed excessively by animals. Rocky ridges are regarded as important areas that act as plant refuges (Carvallo et al. 2019; Buschke et al. 2020). In contrast the *Combretum molle–Englerophytum magalismontanum–Boophone disticha* woodland (5.3) had a much lower diversity. This sub–community is characterized by large rocks covering up to 80% of the area with larger trees and shrubs and steeper slopes. All of these factors contribute to this community having a lower diversity though still high compared to the other plant communities.

Sub-communities 1.1 and 1.2 have 9.19 and 7.99 effective number of species respectively which is ascribed to these communities occurring on very steep scarps with dense vegetation that provides limited habitat for a diversity of species to establish. Yang et al. (2020) and Zeng et al. (2014) found that aspect and slope had a significant influence on species composition and structure with a lower diversity found on steep slopes. The presence of alien invasive species as is the case in sections of this community, can also negatively affect species diversity (Qi et al. 2014).

Community 2 (*Paspalum urvillei–Phragmites australis* valley bottom wetland) overall had the lowest diversity of all the plant communities. This can be ascribed to the homogeneous nature of this valley bottom wetland which is mostly dominated by the reed *Phragmites australis* that form dense stands with few other species in-between. This was also found by Silliman and Bertness (2004) in salt marshes as well as by Lenssen et al. (2000) along riparian zones. Sub-community 2.1 is dominated by the declared alien invader tree *Populus alba* which forms dense impenetrable stands displacing all native species which has resulted in this sub-community achieving the lowest species richness and diversity within the study area. Weber (2003) states that *Populus alba* effectively crowds and shade natural vegetation resulting in a sharp decline in species diversity.

Community 4, the grassland sections occurring on mid-plateau areas had the second highest species richness (ranging between 132 and 280 species per plant community) and diversity (Figs 3, 4). These areas consist of undulating terrain with varying soil, topography and geology (Brown and Du Preez 2014) that provide suitable conditions for various grass and forb species resulting in a high diversity. Grasslands in South Africa are recognised for their high diversity in plant species while Habel et al. (2013) states that grasslands are globally recognised for their high biodiversity.

Conclusions

Vegetation classification and habitat description forms the basis for various other ecological studies, including animal behavioural research. Telperion is located within the grassland biome of South Africa and comprises a variety of plant communities and plant species. Grassland areas are considered as sensitive ecosystems with a high biodiversity. As observed by Brand et al. (2011) grassland communities have a unique dissimilarity when it comes to plant communities found on slopes and footslopes. This has also been found with the plant communities of the Telperion Nature Reserve. This is caused by different

geological substrates, altitudinal differences, varying soil types, aspect and the amount of rock cover.

This study resulted in the identification, description and mapping of 22 plant communities within the 7407 ha Telperion Nature Reserve. These communities can be grouped into 14 sub-communities and five major communities. A total of 551 plant species from 107 plant families and 332 genera have been identified for Telperion. The five major communities identified for Telperion are linked to the topography of the reserve and include ravine woodlands (community 1), valley bottom wetlands (community 2), riparian woodlands (community 3), plateau grasslands (community 4) and rocky woodlands (community 5). The rocky woodland areas had the highest species richness and diversity followed by the mid-plateau grassland areas. This was also found by Brown and Bezuidenhout (2018) in the Nama-karoo area of South Africa where the rocky areas serve as refuge sites for plants of the communities occurring adjacent to the rocky ridges. The various microclimates created by the rocks and varying vegetation cover provide habitat for numerous plant species which results in a higher diversity. The undulating terrain of the mid-plateau areas as well as the variation in soil types (personal observations) provide suitable habitat for a variety of grassland species resulting in these areas having the second highest diversity overall.

The results of this study confirm the findings by Bredenkamp and Brown (2003) and Swanepoel (2006) that Bankenveld is a heterogeneous landscape with a variety of habitats including woodland and grassland components. This study shows Telperion Nature Reserve to be a reservoir of plant species with a high variety of plant communities and plant species diversity, making it an important conservation area. Results provide baseline data that can be incorporated into the management plan for Telperion and adjacent natural areas.

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Supplementary material

Supplementary material 1
Phytosociological table for the vegetation of Telperion Nature Reserve
Link: https://doi.org/10.3897/VCS.85209.suppl1

Supplementary material 2
Images of the major communities of Telperion Nature Reserve
Link: https://doi.org/10.3897/VCS.85209.suppl2